Before the
Federal Communications Commission
Washington, D.C. 20554

In the Matter of	)	
	)	
Amendment of Part 90 of the Commission's Rules	)	WP Docket No. 07-100
	)	

COMMENTS OF NOKIA

Nokia submits these Comments in response to the Sixth Further Notice of Proposed Rulemaking (NPRM) in the above-captioned proceeding,[1] supporting the Commission's efforts to stimulate expanded use of and investment in the 4.9 GHz band.

I. NOKIA SUPPORTS THE COMMISSION'S EFFORTS TO INTENSIFY USE OF THE 4.9 GHZ BAND

Nokia offers unparalleled leadership in the technologies that connect people and things. Nokia is leveraging its strengths to create a new type of network that is intelligent, efficient, and secure, and which will serve as a critical enabler of many capabilities and use cases associated with the Internet of Things (IoT). Nokia brings together, in one company, mobile broadband with fixed line access, and the underlying IP routing and optical technology that connects them. Nokia has made pioneering advancements in reducing the footprint of mobile base station infrastructure, from compact yet full power macro sites down to the full range of small cell solutions, which are expected to be critical to enabling 5G deployment and IoT.

[1] *Amendment of Part 990 of the Commission's Rules*, Sixth Further Notice of Proposed Rulemaking, WP Docket No. 07-100, FCC 18-33 (rel. Mar. 23, 2018) (NPRM).

Critical to its perspective regarding the spectrum bands considered in this proceeding, Nokia has long been a champion of the technologies and policies that can enable the highest and best use of spectrum. Nokia has been actively performing research in spectrum sharing for well over a decade and has developed transformational technologies protected by approximately 80 patents. Nokia is pleased to regularly offer technical analysis in Commission proceedings, which has led to the Commission reallocating and intensifying commercial use in low-, mid-, and high-band spectrum required to keep the U.S. at the leading edge in the race to 5G.

It is in this context that Nokia supports the Commission's current investigation into alternatives that may increase use of the 4.9 GHz Band. Nokia agrees with the Commission's assessment in 2012, reiterated in the current NPRM, that "the band has 'fallen short of its potential.'"[2] Indeed, key voices for the public safety community, such as the Association of Public-Safety Communications Officials International (APCO) and the National Public Safety Telecommunications Council (NPSTC), have recognized that Public Safety use has fallen short of what is expected.[3] Nokia appreciates this honest assessment.

Nokia also appreciates recognition in the NPRM that Critical Infrastructure Industry entities (CIIs) take on what is tantamount to a public safety role in emergencies, and routinely demand exacting standards with respect to

[2] *Id.* ¶ 1.
[3] *See id.* ¶ 2.

performance of their communications networks.[4] As discussed below, CII's respective missions and communications demands are complementary to public safety, and expanding use of the band to CII is a logical step to intensify use of the band in a manner that serves the public interest.

II. CII ENTITIES SHOULD HAVE ACCESS TO DEDICATED SPECTRUM TO MEET THEIR SPECIALIZED NEEDS

CII entities have long sought dedicated, reliable, secure spectrum. In fact, the Commission recognizes in its NPRM three specific industries as quintessential CII, including railroad, power, and petroleum.[5] The Commission correctly recognizes that, "the nature of their day-to-day operations provides little or no margin for error, and in emergencies they can take on an almost quasi-public safety function."[6] Such entities are distinguished from other uses by their need to support real-time interactions with operations, employees, customers, partners and suppliers anywhere and at any time. CIIs use of communications often impacts public welfare and even safety of life. To address this challenge, CIIs need communications networks that provide:

- Reliable wide area connectivity and capacity for people and things
- Efficiency for all mission and business critical communications (internal and external)
- Security and safety
- Low latency, traffic prioritization and the ability to enable rapid endpoint communications

[4] *Id.* ¶ 70.
[5] *Id.*
[6] *Id.* ¶ 70, n.188.

- Agility to rapidly deploy and monetize new services and/or reduce operations costs
- Integration of Internet of Things (IoT).

Nokia believes that these requirements can be addressed through a dedicated wireless network based on the 3GPP wireless standards, and deployed in dedicated spectrum. Dedicated wireless networks offer CIIs full control of all data traffic and applications. Unlike commercial wireless networks designed to serve consumers with non-critical needs, a dedicated wireless network is purpose-built for specific CII use cases and coverage requirements. One such example of use case is for support for smart grid initiatives and expanding connectivity of Field Area Networks (FANs) for utilities.

Dedicated wireless networks allow CIIs to integrate machines, sensors, people, vehicles and things with a very high level of security, service reliability and the performance to meet the requirement of almost all industry vertical applications. With a dedicated wireless network, CIIs get the benefits of wireless broadband, ubiquitous coverage, and mobility that will help drive innovation and speed the adoption of the IoT.

The Figure below shows examples of broader CII use cases for dedicated wireless networks that could include autonomous hauling and monitoring of field/mine operations for the oil and gas exploration segment or advanced train/platform operations, passenger information centers and passenger on-train internet connectivity for the transportation segment.

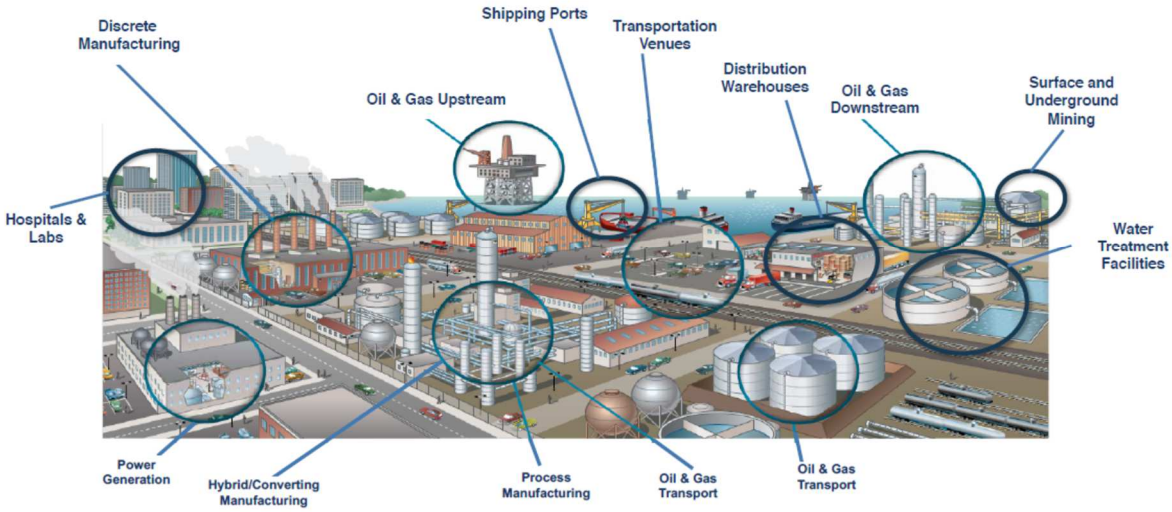

Figure: Sampling of Dedicated Wireless Network CII Applications

III. NOKIA SUPPORTS A 20 MHZ ALLOCATION TO CII AS WELL AS MANY ASPECTS OF THE NPSTC PROPOSAL FOR ADDITIONAL CII CO-PRIMARY LICENCING OVER TIME

Nokia appreciates NPSTC's proposal to extend primary access to the 4.9 GHz band to CII, and agrees with this proposal in many respects. Nokia differs with NPSTC, however, in that we believe that CII should gain immediate co-primary access to 20 MHz of spectrum (not 10 MHz as proposed by NPSTC). Given the nature of the CII segments (e.g., Utility, Oil/Gas, Transportation), the use of 4.9 GHz would geographically overlap. Due to security concerns and requirements within CII segments, it is unlikely for these different segments to use the same spectrum in the same area. Therefore, we envision the 20 MHz being partitioned into multiple, exclusive 5 MHz - 10 MHz blocks that could be used by different CII segments. The Commission correctly states that "the benefits of co-primary use of the band by both

CII and public safety can be realized at slight or no cost to public safety."[7] Nokia respectfully submits that this assessment continues to hold true in our proposal to allocate 20 MHz to CII at the outset for such co-primary CII-Public Safety use.

Nokia further supports the American Petroleum Institute's request that CIIs be permitted to use the band for any purpose, not just in support of public safety.[8] By eliminating the requirement that the band be used for public safety services by CII users, the Commission will facilitate increased use of the band, lowering equipment costs, encouraging wider-spread deployment and facilitating the other benefits of CII access to the band.[9] The need for reliable, secure, dedicated spectrum for CII extends to all communications that lead to safe operation of the CII entity's tasks, and thus communications should not be restricted to public-safety uses for such entities.

Nokia also agrees with NPSTC's proposal to preserve for a period of time public safety's licensing priority in the remainder of the band. In particular, Nokia agrees with NPSTC's proposal to preserve public safety's licensing priority for three years, but allow CII to seek access on a notice basis.[10] Under the proposed notice procedure, a CII entity's application to use unoccupied channels would be put on public notice, and any public safety entity in the same geographic area as the CII entity's planned system would have 30 days to file an application for the same channels, in

[7] *Id.* ¶ 71.
[8] *Id.*
[9] *Id.*
[10] *Id.* ¶ 66.

which case the public safety applicant would prevail. Nokia further agrees that this public safety priority would expire after three years after the Commission's rules become effective, at which point public safety and CII would have equal access to this portion of the band with no required notice.

IV. PUBLIC SAFETY LICENSEES IN THE BAND SHOULD BE ALLOWED TO LEASE SPECTRUM TO CII

Nokia believes that, in addition to extending eligibility to CII to directly license portions of the 4.9 GHz band, the Commission should *also* allow public safety licensees to lease 4.9 GHz spectrum capacity to CII. Allowing the potential for a secondary market for spectrum in this band should be seen as a way to augment the Commission's efforts to intensify use of the band, in a manner that the Commission has found would overwhelmingly benefit public safety. As the NPRM states:

> [we] think the benefits of allowing more efficient spectrum use through leasing can be realized at no cost to public safety. We note that there are potential revenue streams from leasing, further supporting our judgement that allowing leasing would produce benefits that exceed relative costs.[11]

Nokia agrees with the Commission's conclusions. Expanded leasing flexibility stimulate investment in equipment and networks that would benefit public safety and further our objectives for increased use of the 4.9 GHz band.

[11] *Id.* ¶ 79.

V. THE COMMISSION SHOULD CONSIDER THE HARMONIZATION OF ITS TECHNICAL RULES WITH 3GPP 5G SPECIFICATIONS FOR THIS BAND

As the Commission correctly notes in the NPRM, "the lack of available equipment for mobile applications has impeded widespread use of the band by public safety."[12] In order to stimulate expanded use of and investment in the 4.9 GHz band, the Commission should consider harmonizing the rules with 3GPP Technical Specifications developed for 5G New Radio (NR) covering the 4.4-5.0 GHz range and referred to as 3GPP band n79. This would allow public safety and CII to access 5G technologies, since harmonization would help to achieve economies of scale, enable global roaming, reduce equipment design complexity and improve spectrum efficiency. All of this ultimately reduces costs for consumers. In particular, device cost is a significant issue as widely supported spectrum bands and channels can lower the crucial radio frequency (RF) component costs.

3GPP Band n79 is a TDD (Time Division Duplex) band developed for Japan and China and would also cover the U.S. 4.9 GHz range, assuming that the Commission aligns the emission rules with those defined in 3GPP for the Base Station and User Equipment (See Tables below). We also note that these emission masks for band n79 could change in 3GPP but are not expected to deviate too much from the following baseline specification.

[12] *Id.* ¶ 2.

3GPP 5G Wide Area Base Station unwanted emission limits[13]

Frequency offset of measurement filter -3dB point, Δf	Frequency offset of measurement filter centre frequency, f_offset	Emission limits (Note 1, 2)	Measurement bandwidth
0 MHz ≤ Δf < 5 MHz	0.05 MHz ≤ f_offset < 5.05 MHz	$-7dBm - \frac{7}{5} \cdot \left(\frac{f\_offset}{MHz} - 0.05 \right) dB$	100 kHz
5 MHz ≤ Δf < min(10 MHz, Δf_{max})	5.05 MHz ≤ f_offset < min(10.05 MHz, f_offset_{max})	-14 dBm	100 kHz
10 MHz ≤ Δf ≤ Δf_{max}	10.5 MHz ≤ f_offset < f_offset_{max}	-13 dBm (Note 3)	1MHz

NOTE 1: For a BS supporting non-contiguous spectrum operation within any *operating band*, the emission limits within sub-block gaps is calculated as a cumulative sum of contributions from adjacent sub blocks on each side of the sub block gap, where the contribution from the far-end sub-block shall be scaled according to the measurement bandwidth of the near-end sub-block. Exception is f ≥ 10MHz from both adjacent sub blocks on each side of the sub-block gap, where the emission limits within sub-block gaps shall be -13 dBm/1 MHz.

NOTE 2: For BS supporting multi-band operation with Inter RF Bandwidth gap < 20MHz the emission limits within the Inter RF Bandwidth gaps is calculated as a cumulative sum of contributions from adjacent sub-blocks or RF Bandwidth on each side of the Inter RF Bandwidth gap, where the contribution from the far-end sub-block or RF Bandwidth shall be scaled according to the measurement bandwidth of the near-end sub-block or RF Bandwidth.

NOTE 3: The requirement is not applicable when Δf_{max} < 10 MHz.

3GPP 5G User Equipment General spectrum emission mask[14]

Spectrum emission limit (dBm) / Channel bandwidth												
Δf_{OOB} (MHz)	5 MHz	10 MHz	15 MHz	20 MHz	25 MHz	30 MHz	40 MHz	50 MHz	60 MHz	80 MHz	100 MHz	Measurement bandwidth
± 0-1	-15	-18	-20	-21	-22	-23	-24	-24	-24	-24	-24	30 kHz
± 1-5	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	-10	1 MHz
± 5-6	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	-13	
± 6-10	-25											
± 10-15		-25										
± 15-20			-25									
± 20-25				-25								
± 25-30					-25							
± 30-35						-25						
± 35-40												
± 40-45							-25					
± 45-50												
± 50-55								-25				
± 55-60												
± 60-65									-25			
± 65-80												
± 80-85										-25		
± 85-100												

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Nokia appreciates the opportunity to share its views in response to the NPRM. We urge the Commission to take actions consistent with these comments to expand and intensify use of the 4.9 GHz band.

Respectfully submitted,

Nokia

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[13] 3GPP TS 38.104 V15.1.0 (2018-03), NR; Base Station (BS) radio transmission and reception (Release 15).

[14] 3GPP TS 38.101-1 V15.1.0 (2018-03), NR User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone (Release 15).